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SPEAKER BRA WITH WIRELESS SHOVEL CONTROLLER

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ABSTRACT

This paper discusses the development of a new electronic noise instrument using artist-led creative techniques that are informed by dance, sculpture, junk art and post-digital Constructivist aesthetics. [1] The aim is to integrate the gestural and pedestrian performance attributes of dance into live electronic music with a by-product of new creative performance practices and methodologies. The instrument is physical and haptic. It has two parts: a shovel containing movement sensors that acts as a wireless gestural controller, and a bra that contains a sound generating module, amplification and speakers. The instrument is battery powered and independent of laptop devices and large fixed public address systems. The imagery of the instrument approaches the topics of interactive imbalance and the male/female attitudes towards control of any relationship between traditional genders. The design and the agency of this instrument consider the level to which thematic sculptural concepts behind a tool can influence or limit the creative potential of the composer/performer.

Keywords: Kinaesonic, Amplificatory, Garments, Sculpture, Dirty Electronics, Dance, Post Digital, Electronic Instruments, Choreography, Evocative Objects, Live, Performance, Bricolage.

1. INTRODUCTION

The Bra Fig. 1. is a physical, haptic, wearable noise sculpture with feminine human form. It is designed to initiate reaction, conversation and recollection for any individual observing it as either a sculpture or a tool for musical expression. It is provocative and erotic within the context of live electronic music and performance practices by giving focus to the female form [3] and its development as an object can be seen as absurd, humorous and possibly open to ridicule, as with Philip Garner's Blaster Bra [4]. The original intent was to import Nam June Paik's Television Bra [5] into a musical arena by imagining it as a sound-generating object, rather than an image-generating object. This involved including all the sexual, sculptural and gestural relationships embedded in Paik's original work without duplicating his cello work with Charlotte Moorman. The male counterpart, the Wireless Shovel Controller, complements the Speaker Bra with its familiar affordances of a stick and a digging tool that are linked to recent historical masculine activities of accelerated construction. During the Industrial Revolution, studies of shovel design and shovelling techniques took place from 1890 to 1910 to maximize productivity and industrialise the human workforce [6]. In the context of The Bra, the Shovel was a later development in the design of the instrument. Both parts of the instrument have cultural histories regarding their physical form and meaning that date back through millennia [7]. Michele Danjoux presented her non-functional Speaker Bra made for a performance of *UKIYO* as sculptural clothing for the Worker Woman of industrialised Russia [8], which demonstrated how a Constructivist aesthetic can cross from male to female. The Speaker Bra and Wireless Shovel Controller also have identities as products. The Shovel was chosen to objectify male, and the Speaker Bra to augment female, sculpture that would take advantage of their abstract creative potential to bleed between roles using the Constructivist aesthetics of the line as direction and colour as an irrelevant adornment. The construction is left as visible as possible on both objects so that knowledge pertaining to the design of the instrument is available for the audience. They are intended to work in unison as a single instrument and at the same time designed to engender a precarious balance within a performance. The methodology of their construction lies within the Dirty Electronics Manifesto [9], gleaning [10],[11] and bricolage [12]. The visual open-ness of the electronics is based on Constructivism and supported by infra-instruments [13].

FIGURE 1

SPEAKER BRA IN SITU SHOWING SCULPTURAL FORM. WORN BY CHOREOGRAPHER DANAI PAPPA.

This is an instrument for live performance, so the topics of embodiment in live electronic music, and the difficult-to-define subject of liveness were constantly considered and applied

[1] This is a fusion of ideas from Gabo and Pevsner's Realist Manifesto [1] and Necroponte's Post Digital Declaration [2], particularly those aspects where technology and art become everyday and thus invisible.

throughout the design process. These topics were discussed at Live Interfaces in Leeds (2012) [14], Sonorities at Queens University in Belfast (2012) [15] and at The Prophetic Sound Conference in London (2013) [16], so to a certain extent this project is a response to, and a development of, these discussions and notions of embodiment through the act of practice as research.

2. EVOCATIVE OBJECTS

It is important to view the instrument as an 'evocative' object, or a collection of evocative objects that can be seen as both individual component parts and one complete sculptural instrument to which the performer is connected, depending on the mode of perception of the viewer[2]. The performer is the final component in this system and they can begin to develop their own language with which to connect with the instrument and/or its component parts as a creative artist. Donna Haraway describes this cybernetic juxtaposition of imagination, the body and technology in a broadly social context:

> "By the late twentieth century, our time, a mythic time. We are all chimeras, theorised and fabricated hybrids of machine and organism; in short we are cyborgs. The cyborg is our ontology; it gives us politics. The cyborg is a condensed image of both imagination and material reality, the two joined centres structuring any possibility of historical transformation." [17]

As well as politics, the cyborg also gives us an ability to be creative beyond our usual physical boundaries. Our connection to objects is not seamless and constantly in flux. Any issues created by imperfect marriages can become sources of creativity. Haraway continues,

> "Nature and culture are reworked; the one can no longer be the resource for appropriation or incorporation by the other. The relationships for forming wholes from parts, including those of polarity and hierarchical domination, are at issue in the cyborg world." [17]

Perceiving this instrument as an evocative object, or collection of objects, means that it can act as a multi-faceted creative tool with which the performer can become interfaced. Once a human to object connection has been made, the tool becomes active and the performer or observer can begin to work with what has now become a sculptural instrument for performance. This method allows the performer who is acting upon the instrument to construct a personal relationship with it through familiarisation or de-familiarisation. Sherry Turkle describes this process of creating a human relationship with an object thus: "As theory defamiliarises objects, objects familiarize theory. The abstract becomes concrete, closer to lived experience" [18]

The performer, through observation and interaction with the sculptural instrument, develops this familiarisation and de-familiarisation of the component parts and the instrument as a whole. This is one of the continually shifting modes of the relationship between the instrument as a sculpture and the performer. He or she uses this abstract relationship with the instrument to create a symbiotic and cybernetic bond to compose a performance that is unique to the pairing of performer and object. The resulting performance is heavily dependent upon the performer's interpretation of the object (instrument), defined by Turkle's description of a cyborg prism.

> "Once we see life through the cyborg prism, becoming one with the machine is reduced to a technical problem of finding the right operating system to make it (That is, *us*) run smoothly." [18]

Here, Turkle's cyborg prism is a mode of perceiving the usefulness of a sculptural instrument that depends on how familiar it appears to the user, and how much the user is prepared to adapt themselves to the instrument.

2.1 SCULPTURE

Secondary to Paik's TV Bra previously mentioned, the Speaker Bra is an interpretation of The Maschinenmensch, designed by Walter Schulze-Mittendorff for Fritz Lang's Metropolis, which tells the story of an iconic female leader's image being manipulated by political leaders to derail social change [19]. The form of the Speaker Bra has also been cemented by peripheral contemporary environmental impetus during the course of its design and construction. Issues relating to women in music are prominent subjects at the time of writing, for example, women-only hack spaces run by MzTEK [20] emerged in London in 2009 and had gained widespread popularity by 2012. The life of Delia Derbyshire [21],[22] and the lack of prominence of female choreographers [23] have been frequently discussed in the media.

The Speaker Bra has a classic or idealised female form closely based on the body shape of Danai Pappa, the choreographer who will be using the instrument, to strengthen associations of feminine embodiment, female strength as a dancer and strength through Constructivist ideals.

2.2 POST DIGITAL

In The Bra, digital technology (the Arduino) and analogue technology (the Hardware Hacked amplifier) sit alongside hybrid technology in the form of the appropriated receiver and transmitter that use analogue radio and pulse wave modulation. As a unit these form a post-digital system that is primarily led by ideas rather than technology. Even though the physical mechanics, including wires, circuit boards and open speakers, are uncovered and visible, the decisions that were taken as these parts were assembled are invisible, as are their exact function, relationship and interactions with each other. The choice of digital and analogue platforms were not of primary concern, the only concern was that interesting and relevant sounds could be produced with simplicity and at a low cost. This secondary invisible nature of the technology is what gives it strength as a post-digital sculptural concept.

2.3 APPROPRIATION

Appropriation and re-use of discarded objects is an intrinsic part of the methodology of this project. The speakers and the amplifier are taken from the same unit and, with the exception of the short circuits, their technical functionality is unchanged. Sculpturally they have been used to represent parts of the human body, nipples (speaker magnets) and internal organs (the open circuit board). This is a representation of the cyborg and woman as machine. Science fiction authors throughout the Industrial Revolution to the present day have also imagined this representation of a woman as the ideal mate built by man for man [24].

3. TECHNICAL BUILD

3.1 SPEAKER BRA BODY

The shell of the Bra is made from vacuum formed plastic, leather dye and leather off-cuts that were gleaned from a Masters level fashion project [25] by A. Sadkowska, at De Montfort University in 2012. These off-cuts and dye dictated the colour and texture of the instrument. Sadkowska also provided specialist tools and a booklet about the leather working techniques needed to construct the bra, which came

[2] An evocative object is one which evokes a reaction, such as an emotion or a physical action, in the person who is performing an interaction. This reaction is unique to that person.

from Kat Marks' three day leather workshop [26]. This brief and informal collaboration epitomised bricolage as gleaning knowledge as well as material objects. The electronics are arranged in the modular configuration of: a sound generating module, a receiver, an amplifier and a battery box that are all mounted on the leather sections of the Bra. The speakers are mounted with cones facing inward on the plastic section. In this position the cones follow the sculptural form of the body better than if they were facing outwards in a traditional arrangement. They float two to three centimetres above the Perspex mould so that the sound they produce is diffused through the uneven sculptural acoustic reflex properties of the hard surface of the moulded breast, and through the rear of the speaker chassis.

3.2 SPEAKER BRA ELECTRONICS

The sound-generating module for the Speaker Bra Fig.2 is a Ronin 802 Arduino shield [27] mounted on an Arduino UNO[3]. This was chosen for its stability, Graphical User Interface and low cost. The amplifier and speaker cones were gleaned from a Phillips branded Personal Computer speaker set that was found in a skip. The wireless receiver is taken from a cheap second hand Futaba Attack-II remote control system whose circuit is based on the FP8196R integrated circuit (IC). There are two digital to analogue filters between the receiver and the Ronin 802 that convert the Pulse Wave Modulation (PWM) output from the receiver that would normally operate servo motors, to a variable voltage that can be understood by the Ronin 802. A Bluetooth Wii remote and point-to-point Xbee Arduino shields were considered for this task but rejected due to their complexity and unreliability.

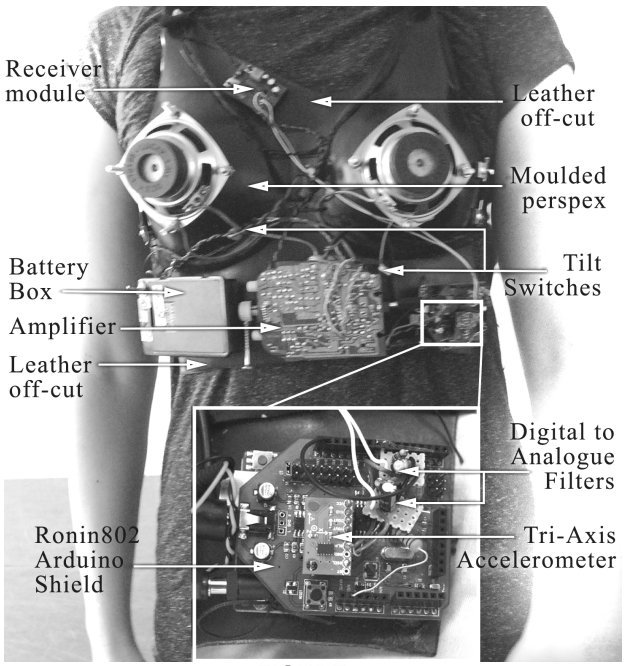

FIGURE 2
THE CONSTRUCTION ELEMENTS OF THE SPEAKER BRA

The PC amplifier has been circuit bent to create two short circuit feedback oscillations in the amplifier board. Two ball bearing tilt switches are placed on the body of the Bra, so that leaning left or right triggers one of the switches. Leaning forwards or backwards triggers both together. Standing upright triggers neither. The sound generated through these actions is of howling distortion.

A third short circuit feedback system in the amplifier board has been created using Nicolas Collins' 'Laying of Hands' technique [28], and has been broken out and connected to the metal chassis of the speaker cones. When the performer touches both speaker chassis, the Speaker Bra produces electronic 'tweets and blurps'. The intention of this modification is to produce erotic gesture. These feedback oscillations are crude and temperamental, and as a result they add uncertainty to the system.

A tri-axis MMA7361 MEMS accelerometer [29] is mounted on the Ronin 802. This gives the performer control of the modulation depth parameter through the motion of the body. This is a digital platform so that parameters can be re-mapped if necessary. In this case modulation depth has been chosen for its drone and phasing characteristics.

Everything runs on six AA batteries that produce 9 volts.

3.3 SHOVEL ELECTRONICS

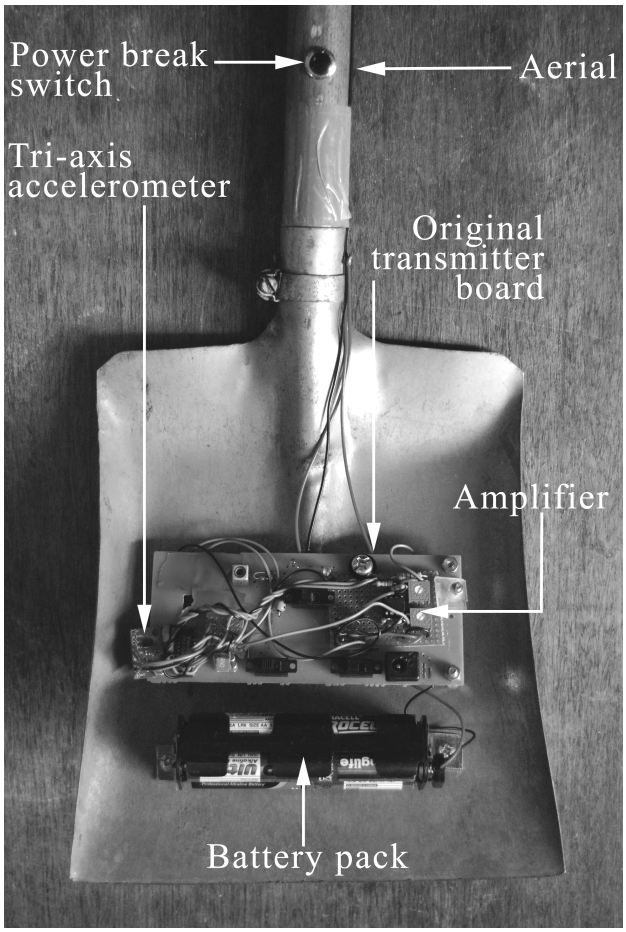

FIGURE 3
THE SHOVEL CONTROLLER WITH WIRELESS TRANSMITTER AND ACCELEROMETER

The Shovel Fig. 3 was found, as bricolage, in the garden shed of my late uncle. I purchased a second hand Futaba Attack II remote control system and removed the transmitter circuit board that is based around the FP2108T IC[4]. I removed the sticks and

[3] The Ronin 802 is a dual oscillator Frequency Modulation digital synthesis module. Its parameters can be adjusted using a Graphical User Interface on a standard home computer. These can be saved on the Ronin 802, rendering it a stand-alone device.

[4] The system originally consisted of four units: a handset controller with two joysticks, a receiver and two servo motors, the latter three items placed inside a vehicle being remotely controlled. The usual application for such a system is in radio-controlled cars, boats and

potentiometers that control the PWM signal and replaced them with a tri-axis accelerometer that is identical to the accelerometer on The Speaker Bra. Two axes on the accelerometer control the voltage of the two transmitter channels. The third is not needed and has become redundant. The voltage from the tilt sensor is amplified and shifted by an inverting amplifier circuit with a virtual ground built around a TL072CN IC. There is a voltage regulator to convert the 12 volts required by the transmitter to 3 volts for the accelerometer. The button on the handle is non-locking, acts as a power break and is wired between the batteries and the transmitter. When the transmitter is off, or out of range of the Speaker Bra, there is a unique effect created as the oscillators on the Ronin 802 lose their signal lock from the tri-axis accelerometer on the Shovel that holds them in position. When this situation occurs, they default to a minimal setting of approximately four oscillations per second, with osculations when the receiver picks up interference. The resulting sound is similar to that of an idling motorbike throttle being occasionally twisted.

4. PERFORMANCE

The Speaker Bra and Wireless Shovel Controller are designed to be stand-alone, free of any laptop system or large public address (P.A.) system. This technical simplicity and out of the box working method allows performers to use their creative thought processes without interruption from technical and analytical thought processes [30]. Being in two parts, the instrument favours the participation of two performers. Having a single performer would be restrictive in a technical and creative sense as without the Speaker Bra, the Wireless Shovel Controller has no function, and without the Shovel Controller the Speaker Bra can only oscillate at one slow fixed speed.

5. DISCUSSION

The Speaker Bra and Wireless Shovel Controller attempt to make a bridge between bespoke tools built for specific compositions, and stand-alone multi-purpose instruments that have no specific project goal. The dual interface structure takes the user back to basic affordances with the human body and a shovel.

Previous similar works include Benoit Maubrey's Audio Ballerinas [31] where clothing plays back samples of the dancers' environment utilising analogue radio as well as amplified umbrellas and metal rods that use contact microphones. These are specifically designed as sculptures in the Electroacoustic tradition and venture into the area of wearable audio. No sensors, evocative objects or short circuits are used and gestural interaction with the sounds is prioritised around sampling sounds, and amplifying percussive objects from a Foley perspective. Michele Danjoux's Speaker Bra makes use of the female form and its erotic potential; it does not create sound, it is pure sculpture designed to present a Constructivist theme in clothing design and performance. Both these artists use speakers in jackets, capes and other sculptural extensions, in the case of Danjoux as fashion and Maubrey as sculpture. The Speaker Bra takes a different perspective in that it is fully functional and encompasses evocative objects, gesture, wireless controllers and Dirty Electronics. These intentionally create gesture and relate it the affordances of the controllers and the electronic sound that is being generated. How the Speaker Bra performs within a compositional environment, and the resulting restrictions and modifications that might be required, will be explored through composition.

The Speaker Bra and Shovel Controller will, by default, have a greater thematic influence over any composition in which it is used than low affordance interfaces that have, arguably, fewer cultural associations due to their multi-purpose design, such as an iPhone or a Wii remote [32]. The project raises the question as to whether their functional specialities have been successfully separated from their cultural associations. Such a separation would allow the instrument to work in a broad creative environment, or the "Universal Stage" described by Oskar Schlemmer, that stretches from the Consecrated Stage to the Circus Stage [33]. It would also enable a creative artist to impose ideas upon the instrument, yet they would also have specialist physical associations for the user that would give them a starting point for their creativity. This bridge between specialist use and universal use is not a blank canvas, and is designed to stimulate and enthuse while having a minimal level of restriction. This is a difficult balance to achieve, but if it is accomplished the instrument can be used to make a reliable qualitative vehicle for demonstrating the complicated relationships between performers, sounds and objects that inform their interactions with the audience.

The Speaker Bra is arguably a Western idealised female shape. This form was taken due to the practicalities of moulding it to Danai's contours. Other sculptures were considered, especially symbols of fertility including the Woman of Willendorf [34] but they did not follow Danai's shape. It is worth mentioning that there is a phallic element to the Wireless Shovel Controller, although this sexual element is more abstract than the sculpture of the Speaker Bra and is more likely to be addressed in a creative compositional environment than in this sculptural space.

6. CONCLUSION

The Speaker Bra with Wireless Shovel Controller is a part of a larger portfolio of sculptural instruments, which makes judging it in its own right a difficult task. Stand alone wearables and interfaces form an area that has had little exploration over the past twenty years with music research focusing on sensors such as proximity, tilt [35] and more recently the whole body using affordable stereo video camera technology in the form of the Microsoft Kinect [36]. The original intent with this project was to import Nam June Paik's Television Bra into a musical arena together with all the sexual, sculptural and gestural implications of Paik's original work. An unexpected outcome of this action is the perception of women in music, both negative and positive, being brought to the fore. I have become aware of this, in conversation with women who feel the gender imbalance in music is so limiting that they wish to remain anonymous rather than risk their careers by describing themselves as feminists. For the subject to be raised in this context, often as a matter of priority and before a single sound has been created, is a measure of the success of the project on a conceptual level. Contemporary political associations of gender have become intrinsically linked to The Speaker Bra element of the instrument.

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REFERENCES

[1] Gavo, N. and Pevsner A. (1920) *The Realistic Manifesto*. Moscow: The Second State Publishing House.

[2] Negroponte, N. (1998) Beyond Digital. *Wired*, 6th Dec. retrieved from: http://www.wired.com/

[3] Rodgers, T. (2010) *Pink Noises: Women on Electronic Music and Sound.* Durham: Duke University Press. pp.35 & 42

aircraft. The servo motors were not needed for this application and were discarded.

[4] Garner, P. (1983) *Philip Garner's Better Living Catalog* London: Sidgwick & Jackson Limited. pp.81

[5] Paik, N.J. (2000) The Television Bra. In: Hanhardt, John G., *The worlds of Nam June Paik,* New York : Guggenheim Museum. pp.70

[6] Taylor, F.W. (1947) *The Principles Of Scientific Management.* New York: Harper & Row. pp. 64-75

[7] Darvill, T. (2003) *The Concise Oxford Dictionary of Archaeology.* UK: Oxford University Press, pp.304

[8] Birringer, J. and Danjoux, M (2013) The Sound of Movement Wearables: Performing UKIYO. *Leonardo Music Journal*, Vol. 46 (No. 3, June) Massachusetts: MIT Press pp. 232-240

[9] Richards, J. (2008) Getting the Hands Dirty. In: *Leonardo Music Journal*, December, Vol 18. pp.25-35

[10] Varda, A. (2000) *The Gleaners and I.* Film. France: Ciné Tamaris

[11] Ferrel, J. (2006) *Empire of Scrounge: Inside The Urban Underground Of Dumpster Diving, Trash Picking and Street Scavenging*. London: New York University Press

[12] Levi-Strauss, C. (1966) *The Savage Mind*. London: Weidenfield and Nicholson.

[13] Archer, P. and Bowers, J. (2005) Not Hyper, Not Meta, Not Cyber but Infra-Instruments. In: *Proceedings of the 2005 International Conference on New Interfaces for Musical Expression (NIME05)*: Vancouver, BC Canada. pp. 5–10

[14] ISCRIM (2012) *LIVE INTERFACES: Performance, Art, Musi.c* [WWW] University of Leeds. Available from: http://icsrim.org.uk/liveinterfaces/ [Accessed 28/7/13]

[15] SARC (2012) *Sonorities Festival of Contemporary Music: The Body's Music.* [WWW] Queens University Belfast. Available from: http://www.qub.ac.uk/sonorities/old/2012/ [Accessed 28/7/13]

[16] Agency of Noise (2013) *The Prophetic Sound: A Day and Night of Noise Cabaret* [WWW] Agency of Noise. Available from: http://agencyofnoise.wordpress.com/2012/12/13/the-prophetic-sound-a-day-and-night-of-noise-cabaret/ [Accessed 28/7/13]

[17] Haraway, D. J. (1991) *Simians, Cyborgs and Women: The Reinvention Of Nature.* New York: Routledge, pp.150 & 151

[18] Turkle, S. (2007) *Evocative Objects: Things We Think With.* Cambridge, Massachusetts: MIT Press. pp. 326 & 307

[19] Schulze-Mittendorff, W. (1927) Maschinenmensch. In: *Metropolis,* (1927). Film. Directed by Fritz Lang. Germany: UFA.

[20] MzTEK (2013) *MxTEK* [WWW] MzTEK, Available from http://www.mztek.org [Accessed 10/7/13]

[21]The *Today Programme* (2013) Delia Derbyshire: 'An incredible figure' [WWW] BBC, Available from http://news.bbc.co.uk/today/hi/today/newsid_9784000/9784517.stm [Accessed 18/7/13]

[22] Long, C. (2013) *Celebrating Doctor Who Pioneer Delia Derbyshire* [WWW] BBC News, Available from http://www.bbc.co.uk/news/uk-england-manchester-20986758 [Accessed 18/7/13]

[23] Jennings, L (2013) *Sexism in dance: where are all the female choreographers?* The Guardian*,* **28th April**, retrieved from: http://www.guardian.co.uk/

[24] Villiers de l'Isle Adam, A. (1886) *The Future Eve.* Paris.

[25] Sadkowska, A. (2012) *The Dys-Appearing Body Project. Design for socio-cultural context of well-being and sustainability*. Unpublished Thesis (MA) De Montfort University

[26] Marks, K. (2013) *KatMarks* [WWW] Kat Marks. Available from: http://www.katmarks.com/ [Accessed 01/08/13]

[27] Frize, J. (2013) *Roninsynth* [WWW] Sonodrome. Available from: http://www.roninsynth.com [Accessed 20/07/13]

[28] Collins, N. (2009) *Handmade Electronic Music: The Art of Hardware Hacking*, 2nd Ed. Oxon: Routledge. pp.78

[29] Sparkfun (2013) *Triple Axis Accelerometer Breakout - MMA7361* [WWW] Sparkfun. Available from: https://www.sparkfun.com/products/9652 [Accessed 20/07/13]

[30] Popova, M. (2013) Sister Corita Kent's Timeless Rules for Learning and Life, Hand-Lettered by Lisa Congdon. *Brainpickings.* Weblog [Online] 27 February. Available from: http://www.brainpickings.org/index.php/2013/02/27/sister-corita-kent-lisa-congdon/ [Accessed 01/08/13]

[31] Maubrey, B. (1995) Audio Jackets and Other Electroacoustic Clothes In: *Leonardo Music Journal*, Vol.28, No.2, pp.93-97

[32] Spowage, N., Tanaka, A. and Allessandro, A. (2012) Gestural Musical Affordances. In: *Proceedings of Sound and Music Computing Conference* Copenhagen: Aalborg University.

[33] Schlemmer, O, Moholy-Nagy, L. and Molnar, F. (1961) *Theatre of the Bauhaus.* Michigan: Wayne State University Press. pp.19

[34] Walpurga, A. W. (2012) *The Anthropomorphic Figurines of the Willendorff.* [WWW] Oberösterreichisches Landes Museum. Available from: http://www.landesmuseum.at/pdf_frei_remote/WM_19_0019-0030.pdf [Accessed 03/08/13]

[35] Sonami, L. (2001) *The Lady's Glove*. Developed by Bongers and Haag at STEIM, Amsterdam. Available at: http://www.sonami.net/works/ladys-glove/ [Accessed 12th May 2013]

[36] Robinson, A. (2012) *Ph.D. candidate develops application to manipulate sound* [WWW] Duke Student Publishing Company. Available from: http://www.dukechronicle.com/articles/2012/02/13/phd-candidate-develops-application-manipulate-sound [Accessed 28/7/13]